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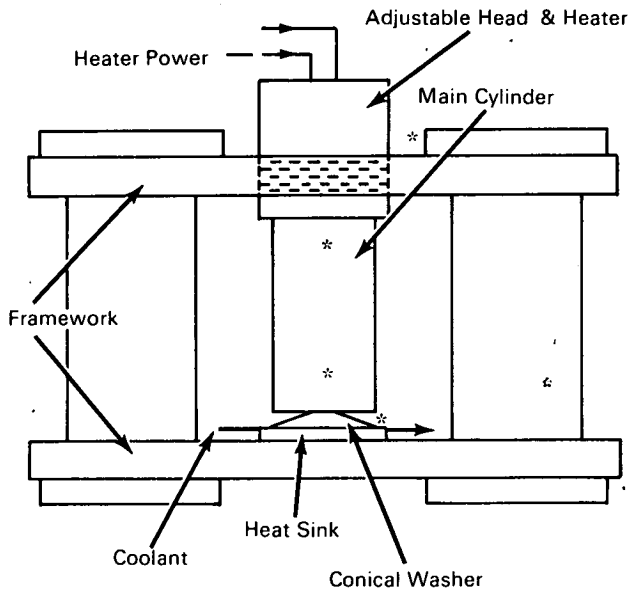
NASA TECH BRIEF

Passive Heat Transfer Control

The problem of maintaining a preselected temperature in the near vicinity of a variable source of thermal energy has been recently investigated. One typical situation is a solid state power circuit that generates heat, dependent on power requirements, and the stability of which is temperature dependent.



A useful concept has been reduced to an operating prototype stage that exhibits the desired characteristics of passive thermal control. The model used consists of a rigid framework mounting active elements as shown in the figure. The adjustable head contains a resistance wire heat source operated by 60-cycle ac and has a maximum output of approximately 2000 Btu/hr. A solid cylinder of 6061 T6 aluminum exerts vertical motion and force, as a result of thermal expansion on a conical washer which rests on a water-cooled heat sink.

Heat input to the main cylinder is controlled by a variable transformer, and a voltage drop across the heater is used to calculate power dissipated in conjunction with the known resistance of the heater. Heat sink temperature is held essentially constant by a large flow of tap water and is monitored by periodic sampling of water inlet and outlet temperature and temperature at a selected point on the heat sink shell.

This model control is used as the basis for predictions of control temperature as a function of the preload, or initial gap at the outer edge of the conical washer with all elements of the control at known temperatures. Heat "leakage" through the two rings of contact at the washer, prior to full compression, controls heat flow before the control point is reached. Contact conductance between the annular area of the washer and the hot cylinder and heat sink governs temperature of the cylinder after full compression of the washer is accomplished.

Notes:

1. Results of two control runs designed to control at average cylinder temperatures of 150° and 185°F, show positive control especially at the higher temperature run in which control was achieved well within 5°F of predicted average cylinder temperature.
2. The thermal conductance behavior of the conical washer appears ideal for this application with the exception of the relatively high initial "leakage" through the circular contact points.

(continued overleaf)

3. Requests for further information may be directed to:

Technology Utilization Officer
Headquarters
National Aeronautics
and Space Administration
Washington, D.C. 20546
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Patent status:

No patent action is contemplated by NASA.

Source: Frank A. Fitz of
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